

Prediction of Microstructure Evolution in DMLM processed Inconel 718 with Part Scale Simulation

Completed Technology Project (2017 - 2020)



Project Introduction

The goal of this project is to develop part-scale process-microstructure simulation tool to predict the microstructure evolution of Inconel 718 processed by powder bed laser fusion process. To achieve this goal, research efforts will be focused on (1) incorporating materials thermokinetics into thermal modeling for cyclic superheating and supercooling processes; (2) developing a new integrated phase transformation and grain texture model to predict microstructure evolution under complex heating and cooling cycles with high fidelity; (3) exploring simultaneous time scale parallelization and adaptive meshing to accelerate thermal modeling for part-scale process simulation. These innovations will lead to a robust simulation toolkit capable of predicting microstructure in an as-fabricated AM part given the process parameters.

Anticipated Benefits

Maximize freedom to design materials microstructure based on created reliable model. The proposed process-microstructure modeling demonstrates the way to perform an efficient design-level simulation providing the method to evaluate in-situ phase stability. Leading a direct approach to optimize laser process parameter to improve mechanical properties through designable as fabricated microstructure. Paving the way for the future development of a simultaneous microstructure-topology optimization framework for the designing of AM structural metal components. The proposed model can be directly adopted in design route for AM components leading a significant shortened design-cycle, and will assist in certifying an AM part for space mission.



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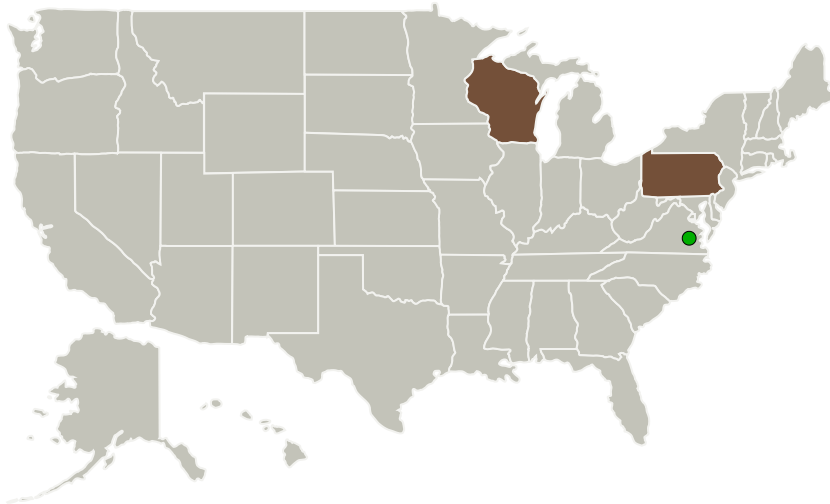
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Pittsburgh-Pittsburgh Campus	Lead Organization	Academia	Pittsburgh, Pennsylvania
ANSYS, Inc.	Supporting Organization	Industry	
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia
University of Wisconsin-Madison	Supporting Organization	Academia	Madison, Wisconsin

Primary U.S. Work Locations

Pennsylvania	Wisconsin
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Project Website:

<https://www.nasa.gov/strg#.VQb6T0jJzyE>

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of Pittsburgh-Pittsburgh Campus

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

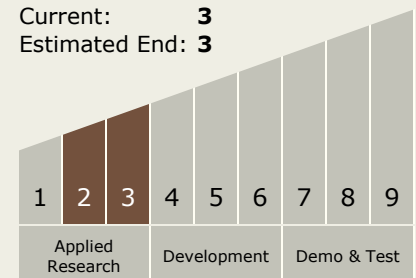
Hung D Nguyen

Principal Investigator:

Albert To

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX15 Flight Vehicle Systems
 - └ TX15.2 Flight Mechanics
 - └ TX15.2.4 Modeling and Simulation for Flight

Target Destination

Outside the Solar System